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A FAST ELECTRON GUN FOR STUDY OF ATOMIC DECAYS

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ABSTRACT

A fast electron gun with subanosecond rise- and decay-times and 100 ma. peak beam current has been developed for delayed coincidence studies of atomic decays. The gun is fabricated from an inexpensive tetrode Nuvistor, involving only slight modification.

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SUMMARY

A fast electron gun has been developed for use in delayed coincidence studies of nanosecond atomic lifetimes. The gun is fabricated from readily available, inexpensive vacuum tubes which are modified to provide subnanosecond switching times and peak currents of $\sim$100 ma. for pulse durations $\lesssim$ 2 nsec.

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A fast electron gun has been developed for use in studying the decays of excited states in gases[1] by a delayed coincidence technique. This gun would prove useful, however, wherever a source for a 100-300 eV electron beam with subnanosecond switching times is required. Of course, due to the presence of the oxide coated cathode, its use must be limited to inert atmospheres.

The gun consists of a modified 7587 Nuvistor with the metal shell cut away just above the base. As shown in Fig. 1, a low impedance ground connection is provided for the first grid by spot welding three short wires to the grid supports and the remaining portion of the metal envelope. The modified 7587 is then inserted into a standard Nuvistor socket which has been soldered into the end of a UHF connector (Fig. 2). The connector serves both as a mechanical support and as the input signal connector.

The grounded grid configuration of Fig. 3 was found to provide low pulse distortion and good matching to the input cable impedance. The special coupling capacitor shown is a modified coaxial unit, General Radio type 874K. Performance was verified by collecting the radial electron beam in a 1/4'' diameter cylinder mounted inside a UHF elbow connector (hidden by the disk in Fig. 4), and plotting with the aid of an X-Y recorder coupled to the time sweep of a sampling oscilloscope, the input and output current pulse shapes (Figs. 5 and 6, respectively). The output pulse exhibits rise and fall times of the same order (0.3 nsec.) as the input pulse indicating, assuming the risetimes add as the square root of the sum of the squares, that the electron gun has rise- and fall time of $\lesssim 0.1$ nsec.

Where an input pulse of $\sim$ 200eV is available, so that a separate acceleration potential supply and a second grid are not necessary, another variety of Nuvistor, the 8627 grounded grid triode, has been found to give even better performance. Risetimes at least as fast as $\sim$ 0.1 nsec. were observed along with an almost complete lack of ringing on the output pulse wave form. Whereas peak currents of $\sim$100 ma. are normal for the 7587 driven with a 10 volt pulse, the 8627 is capable of peak currents of $\sim$ 1 ampere when driven with 200 volt pulses of durations $\leq$ 2 nsec.

REFERENCES

1. J. F. Sutton, Doctoral Dissertation, Measurement of Relative Cross Sections for Simultaneous Ionization and Excitation of the Helium 4^2S and 4^2P States, American University Library.

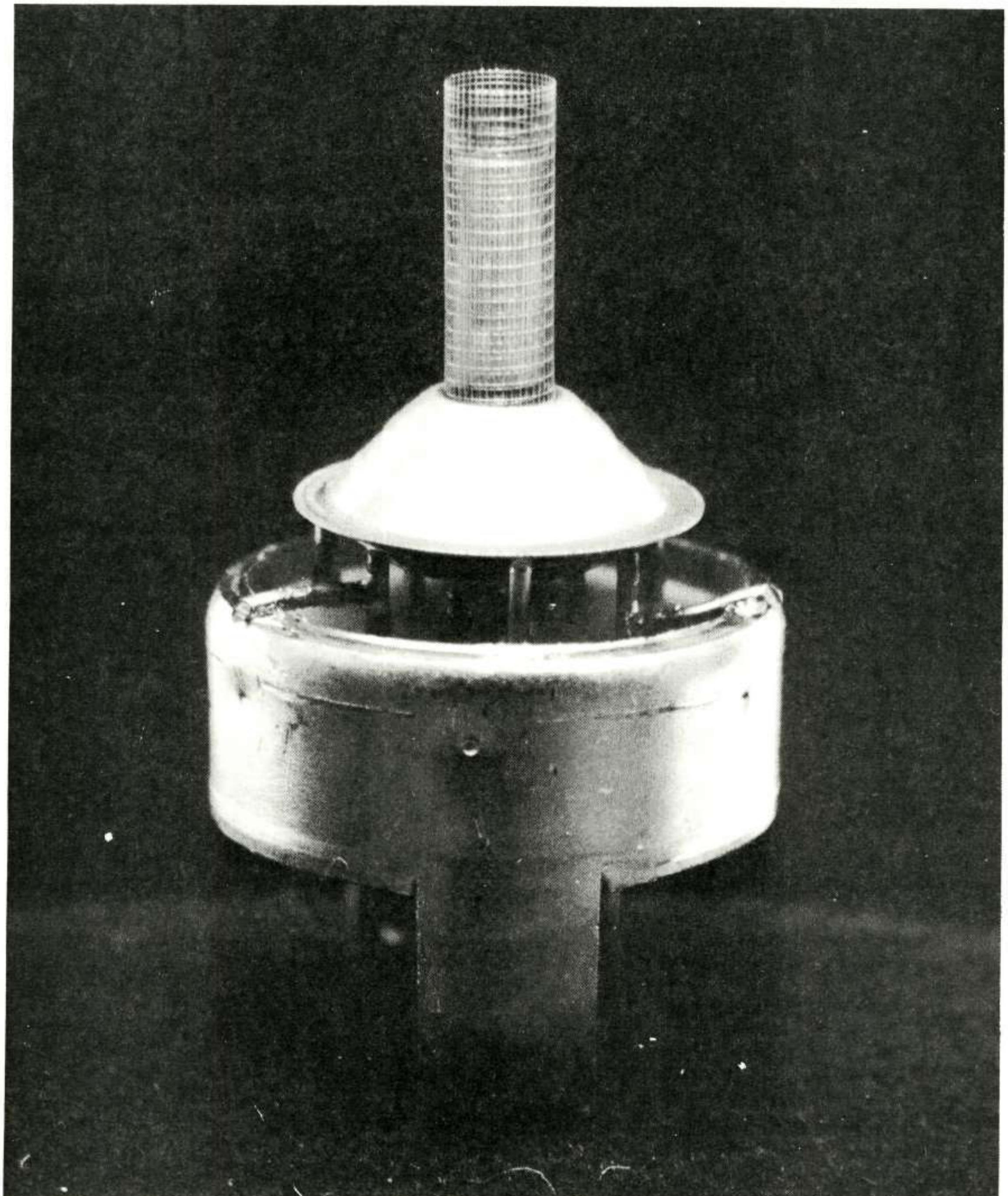

Figure 1. Modified 7587 Nuvistor Electron Gun

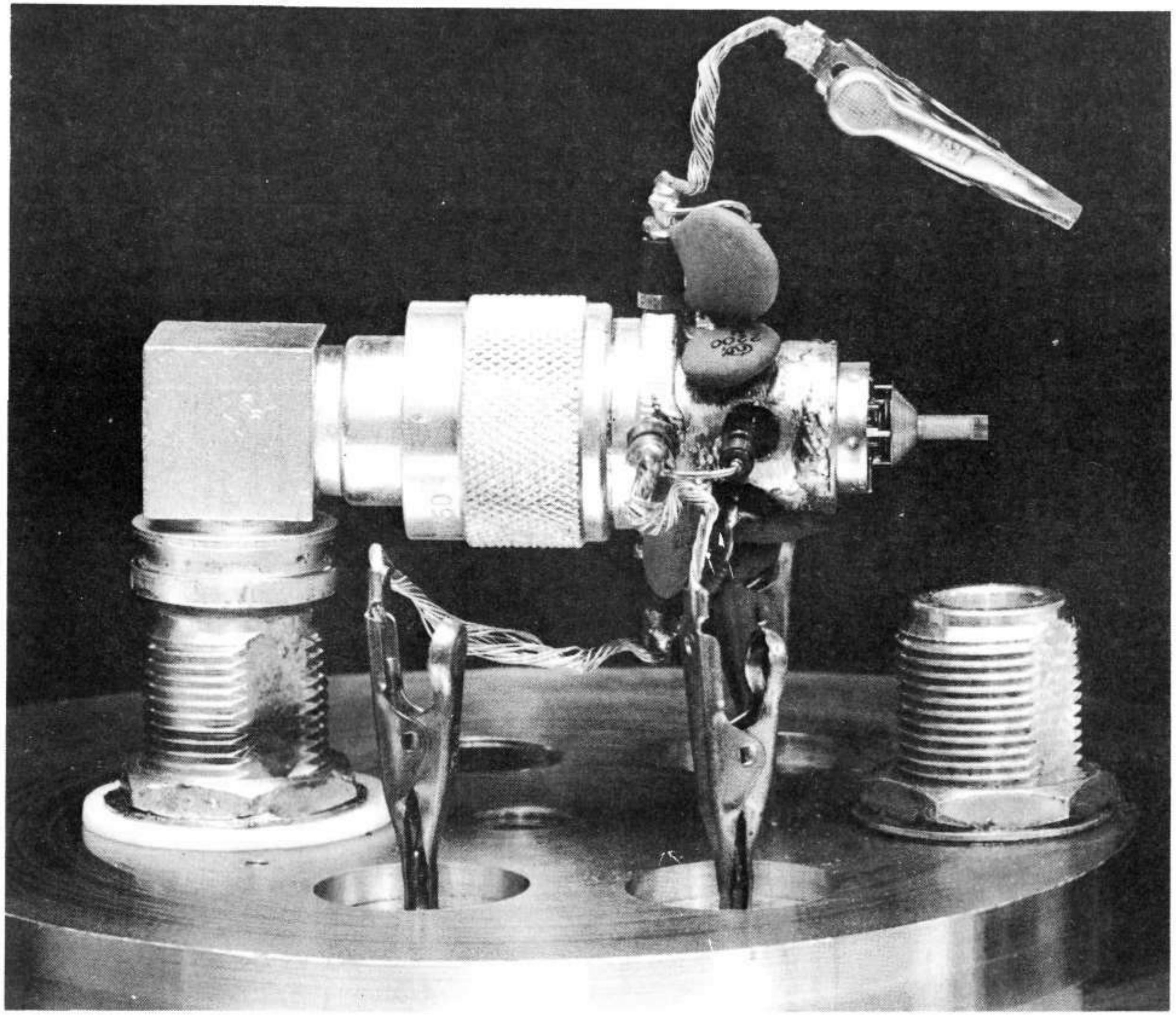

Figure 2. Electron Gun Assembly, Electron Collector Removed

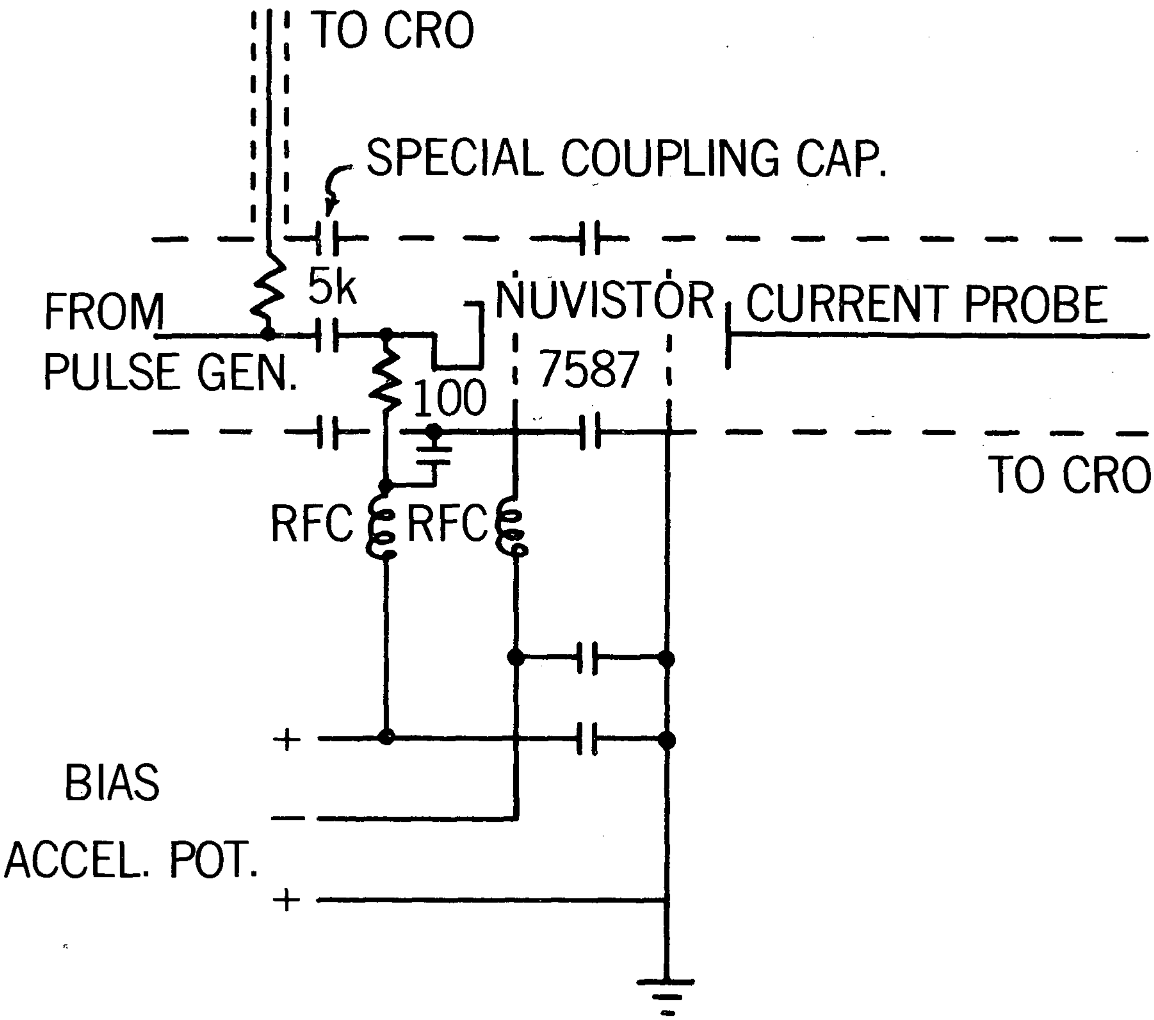

Figure 3. Schematic Diagram of Electron Gun Circuit

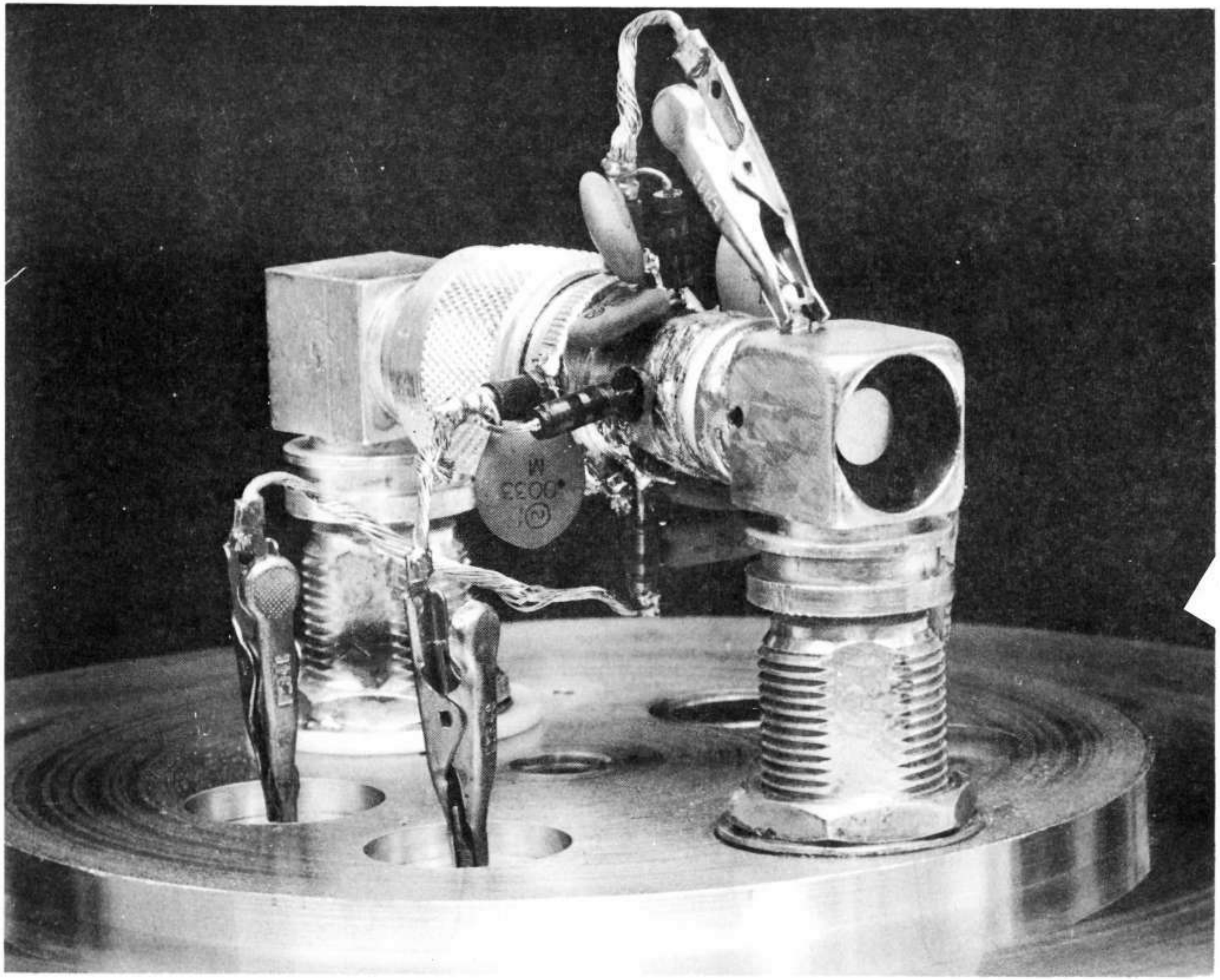

Figure 4. Complete Electron Gun Assembly

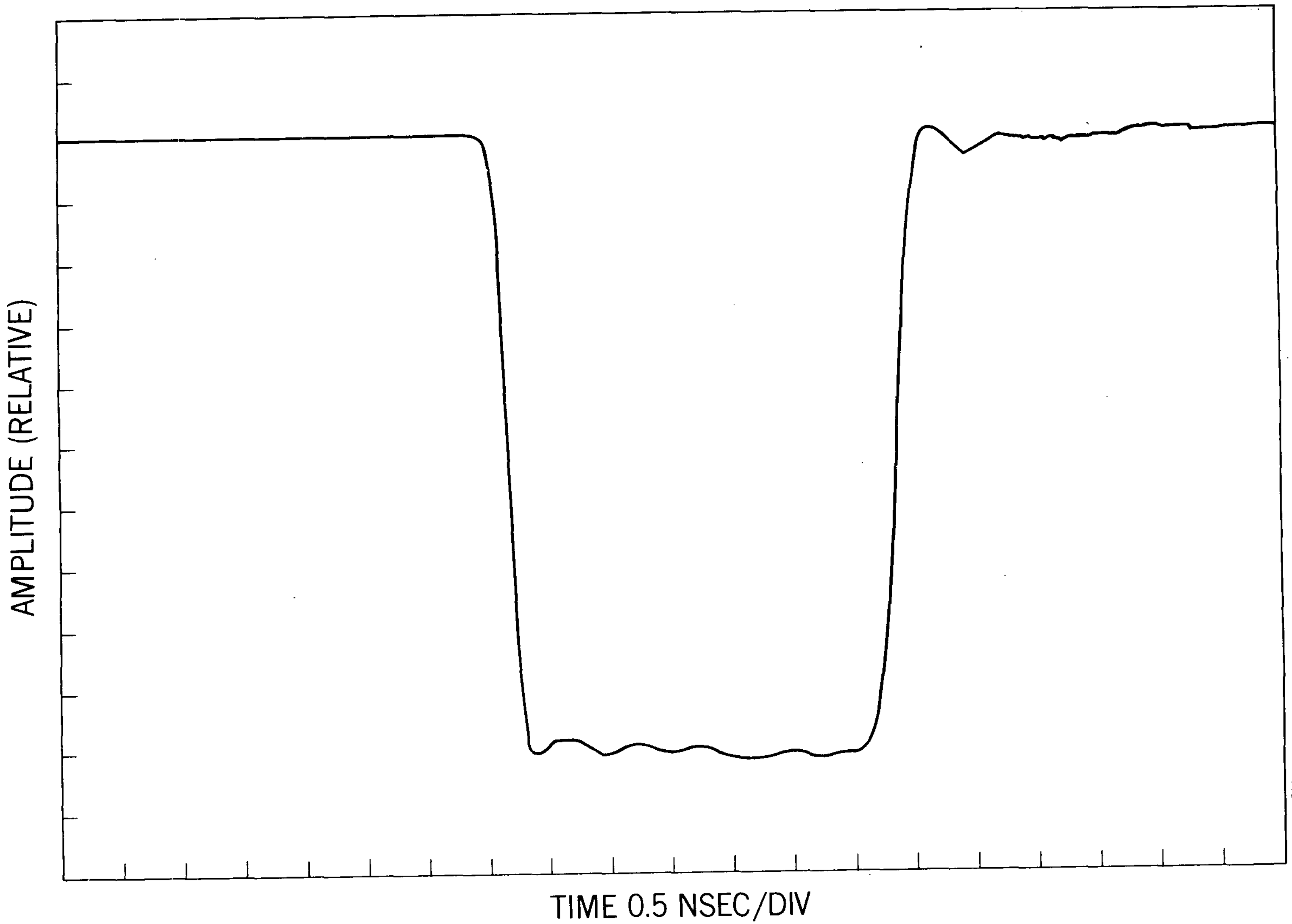

Figure 5. Input Current Pulse

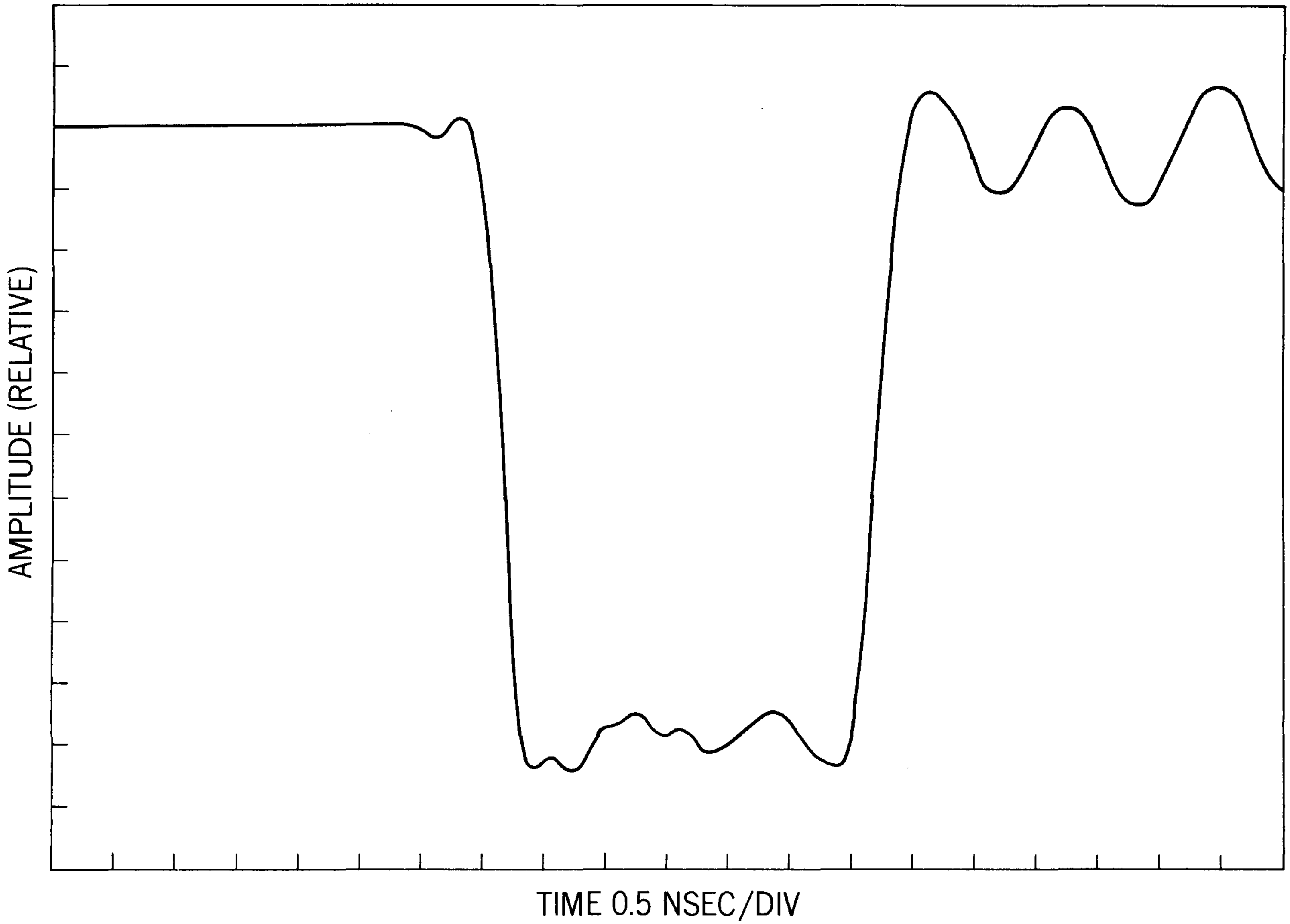

Figure 6. Output Current Pulse